ISTANBUL BRIDGE CONFERENCE
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EXPERIMENTAL MEASUREMENTS ON TEMPERATURE GRADIENTS IN CONCRETE BOX-GIRDER BRIDGE UNDER ENVIRONMENTAL LOADINGS

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INTRODUCTION AND AIM OF THE PAPER

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THE EXPERIMENTAL BOX-GIRDER SEGMENT

Figure 1: Concrete casting of the experimental full-scale box-girder segment

THE EXPERIMENTAL BOX-GIRDER SEGMENT

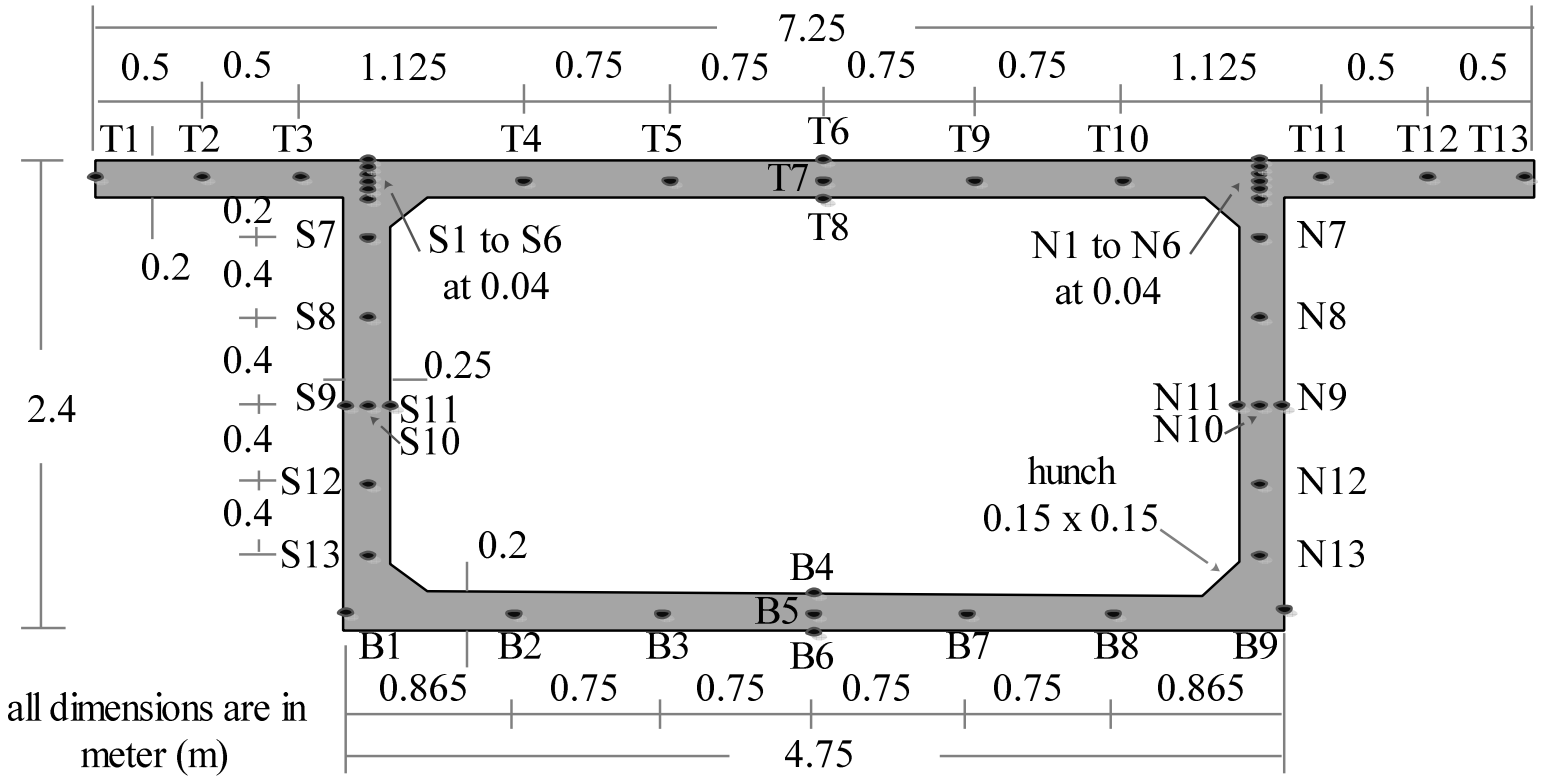

Figure 2: Dimensions of the cross-section of the box-girder segment and the locations of thermocouple

TEMPERATURE-TIME CURVES

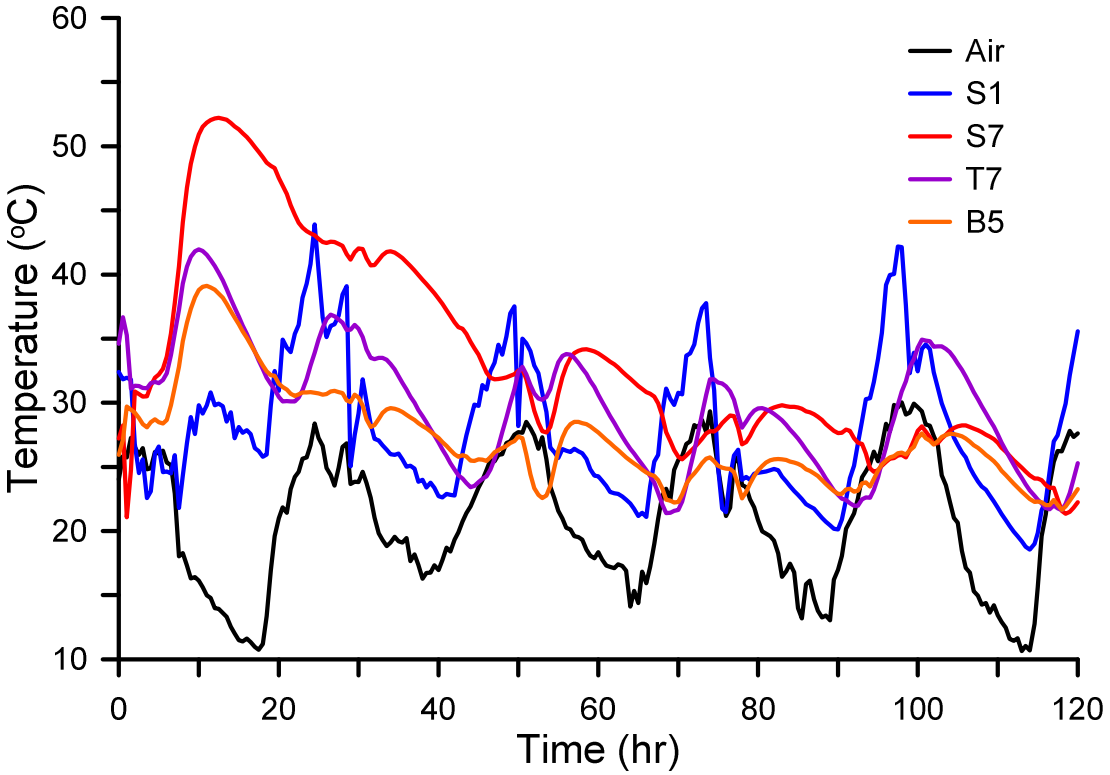

Figure 3: Temperature time curves during the first five days for Air, S1, S7, T7, and B5

VERTICAL TEMPERATURE DISTRIBUTIONS AND GRADIENTS

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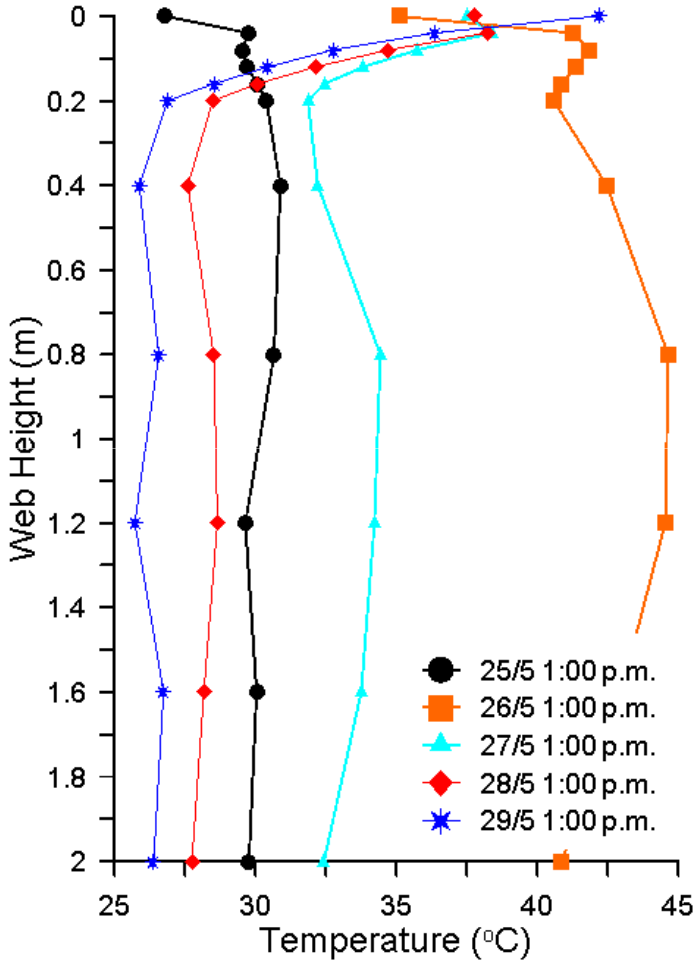


Figure 4: Vertical temperature distributions for

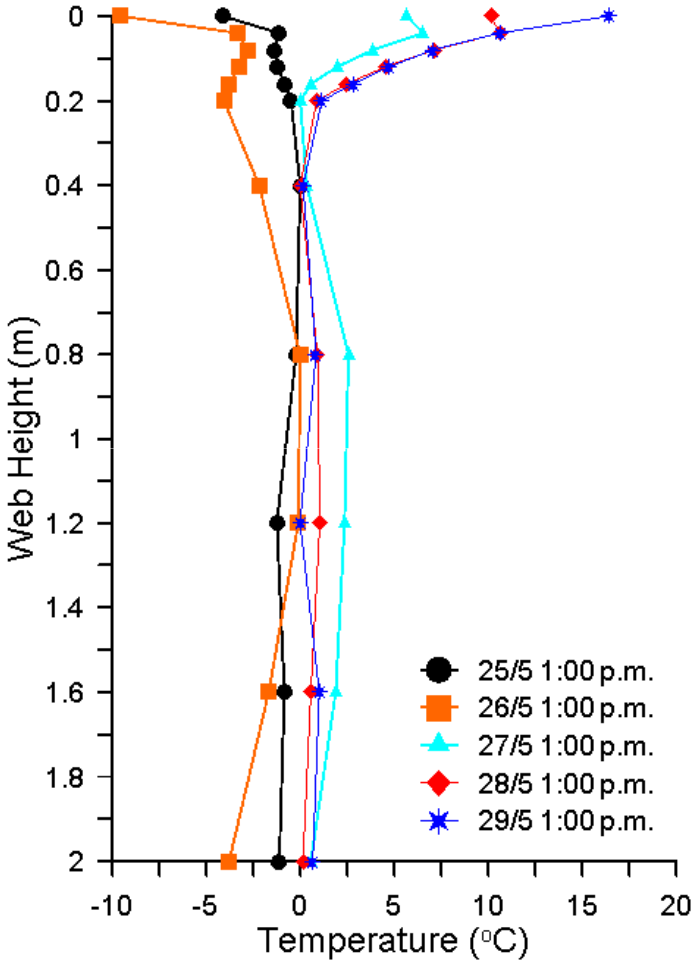
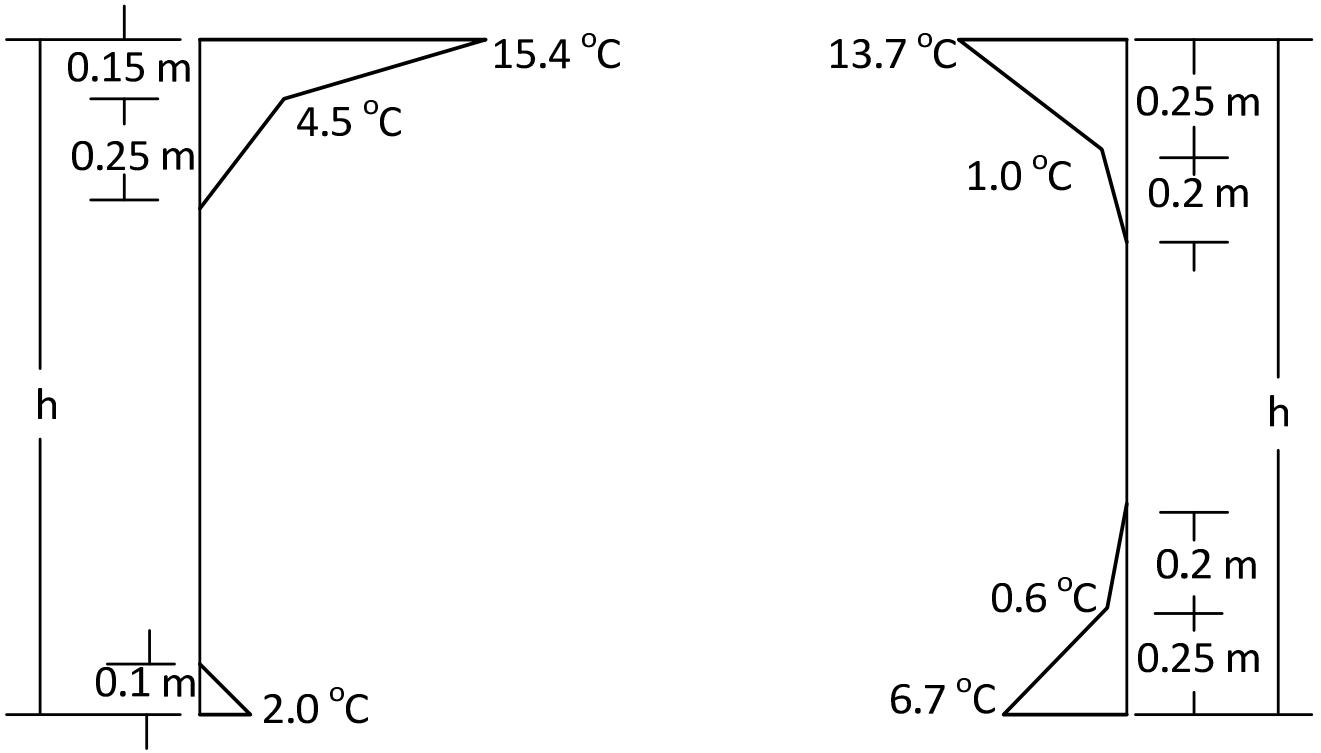


Figure 5: Vertical temperature gradients for

COMPARISON WITH THE DESIGN GRADIENTS OF EN 1991



(a) Heating (b) Cooling

Figure 6: Temperature gradient model of concrete box-girders of ENI 991 (a) heating and (b) cooling

COMPARISON WITH THE DESIGN GRADIENTS OF EN 1991

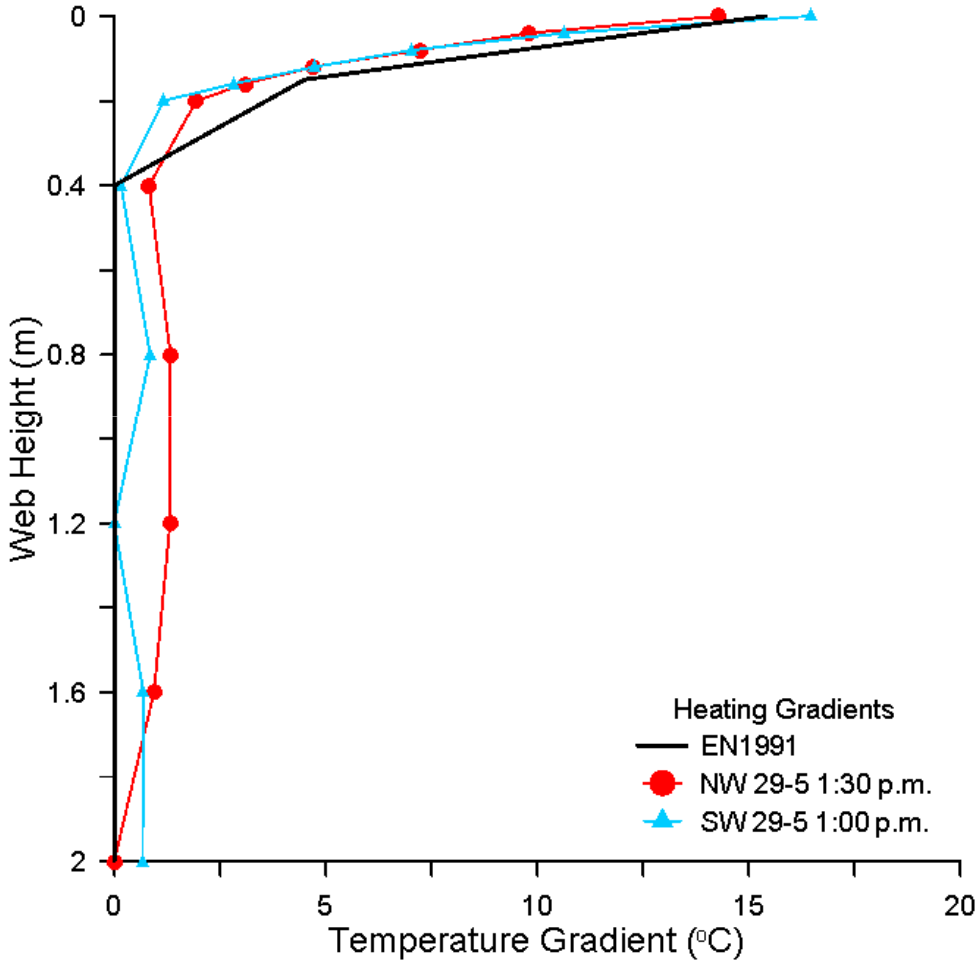


Figure 7: Comparison of the positive (heating) gradients with EN1991

COMPARISON WITH THE DESIGN GRADIENTS OF EN 1991

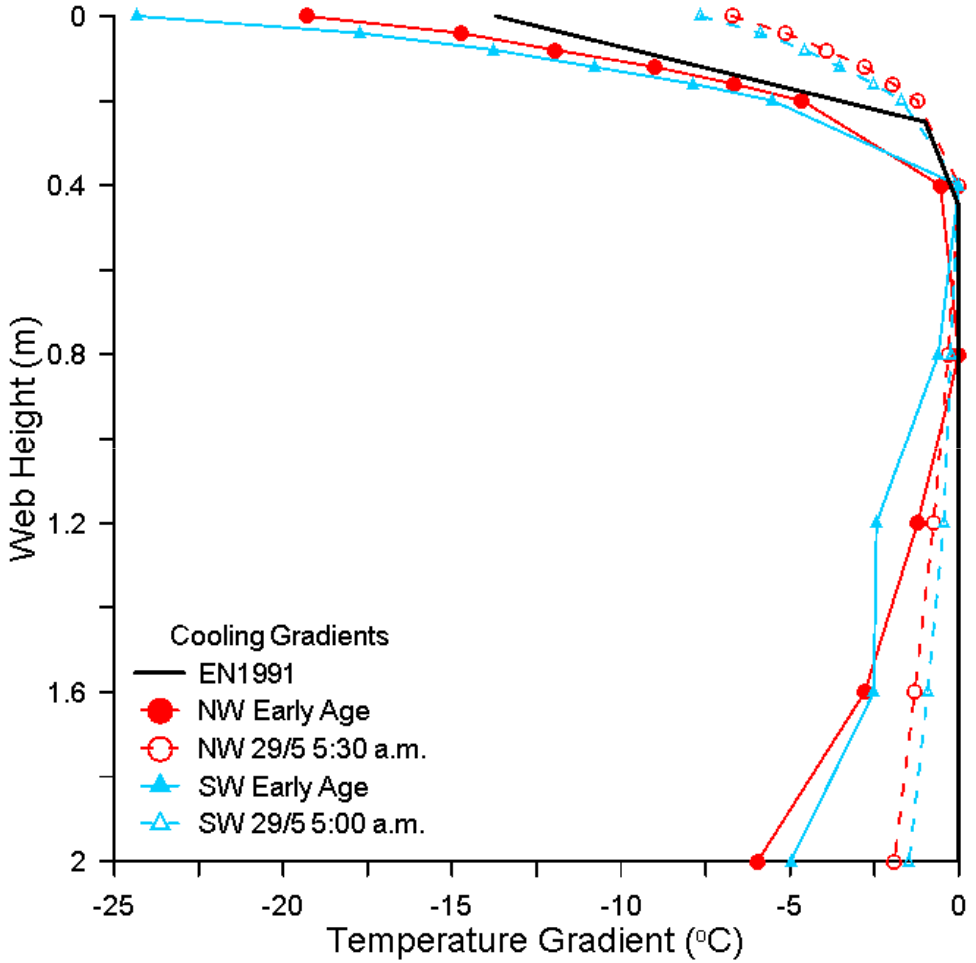


Figure 8: Comparison of the negative (cooling) gradients with EN1991

CONCLUSIONS

From the results of the thermocouples and the environmental sensors of this study, the following conclusions can be drawn,

1- During the early age of concrete, the effect of hydration heat was significant, which reached its maximum after about 12 hours, at which the recorded maximum vertical temperature gradient was approximately 25°C. After 48 hours, the effect of hydration heat decreased significantly, while it diminished after about 100 hours.

CONCLUSIONS

2- The effect of hydration heat on temperature readings influenced mainly by the location of thermocouples, the distance from the nearest exposed surface and the degree of sealant from formwork. Interior thermocouples that were surrounded by larger mass of concrete followed the behavior of hydration heat with time, while surface thermocouples followed the fluctuation of air temperature with time even during the early hours of concrete age.

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CONCLUSIONS

3- Due to the effect of hydration heat, the temperatures of the webs' interior thermocouples kept higher than of the surface thermocouples during most of day hours of the next day, causing negative vertical temperature gradients in spite of the gradual worming of the top surface by solar radiation.

After 48 hours, this effect decreased significantly and the vertical temperature gradients became closer to those of aged concrete with positive gradients during the day hours and negative gradients during the night hours.

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CONCLUSIONS

4- For the region of Gaziantep, Turkey, the EN1991 positive (heating) temperature gradient provisions are insufficient for concrete box-girder bridges. While the EN1991 negative (cooling) temperature gradient can be considered satisfactory for the same region.

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